The GOES-R Proving Ground Partnership

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- What is the GOES-R Proving Ground?
- Examples of GOES-R Proxy Products tested at:
  - Cooperative Institutes
  - HWT Spring Experiment
  - NHC 2010 Hurricane Season
  - Aviation Testbed at AWC and Alaska
- Lessons Learned and User Input
- PG activities in 2011
- Summary

GOES-R Proving Ground

- What is the GOES-R Proving Ground?

  - Collaborative effort between the GOES-R Program Office, selected NOAA/ NASA Cooperative Institutes, NWS forecast offices, NCEP National Centers, JCSDA, and NOAA Testbeds.

  - Where proxy and simulated GOES-R products are tested, evaluated and integrated into operations before the GOES-R launch

  - A key element of GOES-R User Readiness (Risk Mitigation)

Proving Ground Mission Statement

The GOES-R Proving Ground engages NWS in pre-operational demonstrations of selected capabilities of next generation GOES

- Objective is to bridge the gap between research and operations by:
  - Utilizing current systems (satellite, terrestrial, or model/synthetic) to emulate future GOES-R capabilities
  - Infusing GOES-R products and techniques into NWS operations with emphasis on AWIPS and transitioning to AWIPS-II.
  - Engaging in a dialogue to provide feedback to developers from users

- The Proving Ground accomplishes its mission through:
  - Sustained interaction between developers and end users for training, product evaluation, and solicitation of user feedback.
  - Close coordination with GOES-R Algorithm Working Group (AWG) and Risk Reduction programs as sources of demonstration products, promoting a smooth transition to operations
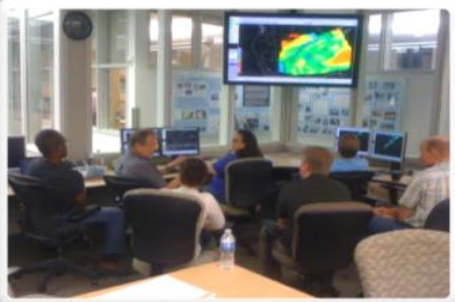
Intended outcomes are Day-1 readiness and maximum utilization for both the developers and users of GOES-R products, and an effective transition to operations
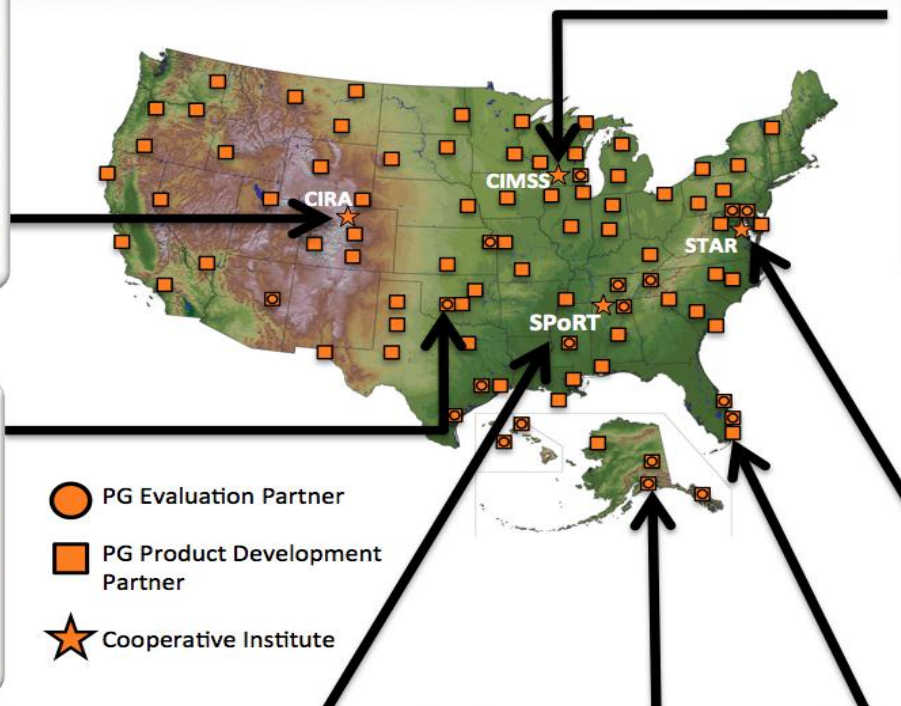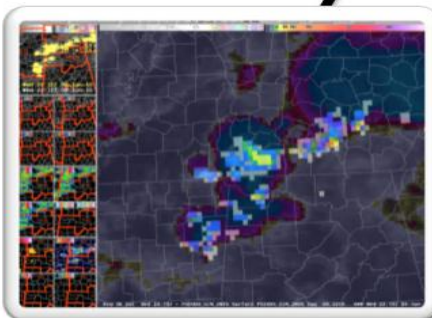
GOES-R Proving Ground Partners
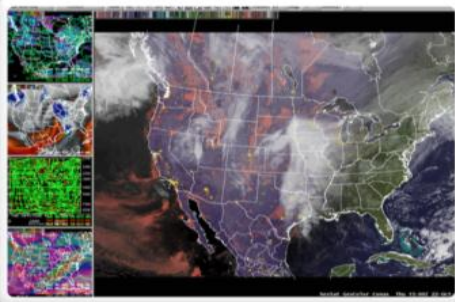
CIRA - Ft. Collins, CO
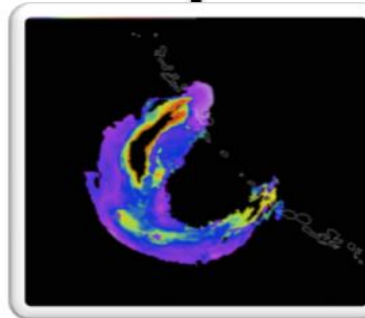ABI Simulated Natural Color

SPC – Oklahoma City, OK
Nearcast Training at the Hazardous Weather Testbed

CIMSS – Madison, WI
Simulated ABI Bands

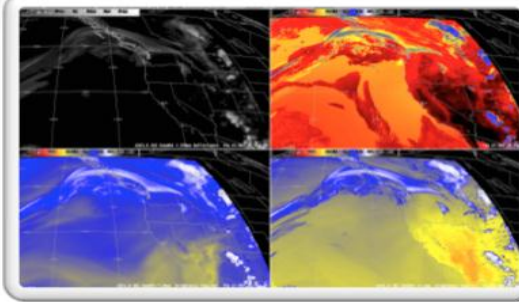**STAR – Camp Springs, MD**
Aerosol Optical Depth Product

PG Evaluation Partner

PG Product Development Partner

Cooperative Institute

SPoRT – Huntsville, AL
GLM Lightning Flash Density

AFC – Anchorage, AK
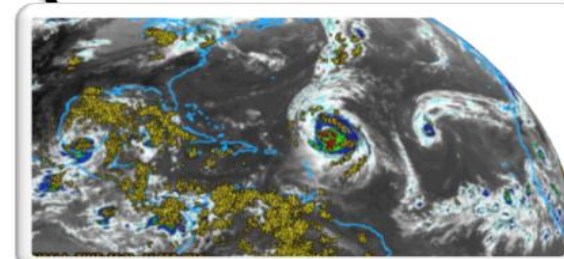Volcanic Ash Product

NHC – Miami, FL Rapid Intensification Index

Proving Ground Product Evaluation

The following products are part of current GOES-R Proving Ground demonstrations:

Baseline Products

- Cloud and Moisture Imagery
- Volcanic Ash: Detection and Height
- Hurricane Intensity
- Lightning Detection: Events, Groups & Flashes
- Rainfall Rate/QPE
- Total Precipitable Water
- Fire/Hot Spot Characterization
- Cloud Top Phase
- Cloud Top Height
- Cloud Top Temperature
- Derived Motion Winds
- Aerosol Detection
- Aerosol Optical Depth

Future Capabilities

- Aircraft Icing Threat
- Convective Initiation
- Enhanced "V"/Overshooting Top Detection
- Low Cloud and Fog
- SO_2 Detection

2011 Product Demonstrations

- Severe Weather: NWS SPC and Hazardous Weather Testbed
  - Improved versions of 2010 products, Cloud and Moisture imagery, Nearcasting
  - 24 forecasters participated from across the country over a 5-week period May-June,
  - 2-week fire weather demonstration in August
- Hurricanes and Tropical Cyclones: NWS NHC Testbed
  - Gain more experience with RGB products
  - Continue evaluation of lightning input
  - Potential new products: Overshooting tops, and product to discriminate thin from thick cirrus over tropical cyclones, true color products
  - Provide RGB products in N-AWIPS format
- Aviation Weather: OCONUS - Pacific and Alaska Regions, Alaska Aviation Weather Unit and NWS AWC (Kansas City)
  - Cloud top height and phase (Alaska only)
  - Fog/low cloud probability
  - Volcanic ash mass loading, height, and particle size
  - SO_2 detection and loading
  - Convective initiation
  - Nearcasting (AWC only)

Demonstrations 2011 HWT/SPC Spring Experiment

Location
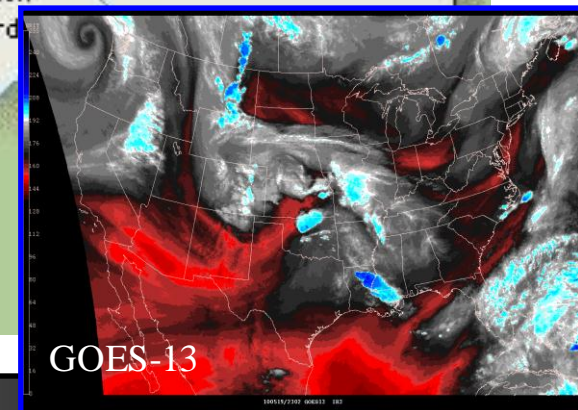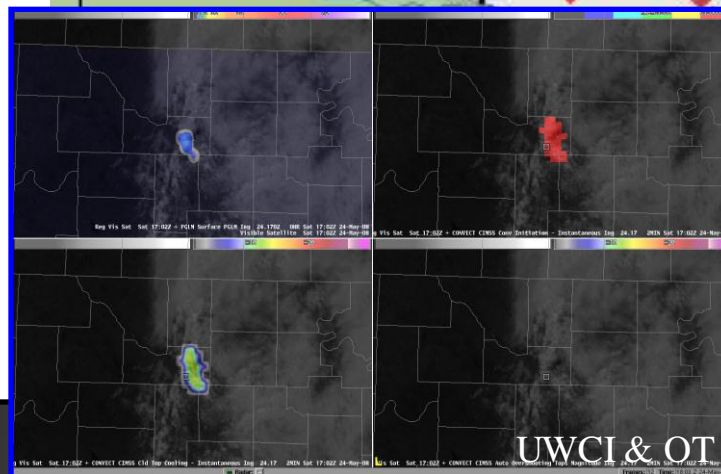-Hazardous Weather Testbed/Storm Prediction Center, Norman, OK
Focus
-Convection
Products
-Cloud and moisture imagery
-Convective initiation
 - 3 products
-Overshooting-top / Enhanced-V detection
-Total lightning detection
 - 2 products
-Severe hail probability
-Nearcasting product
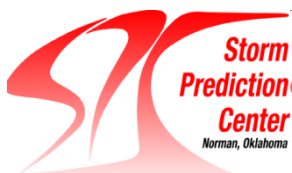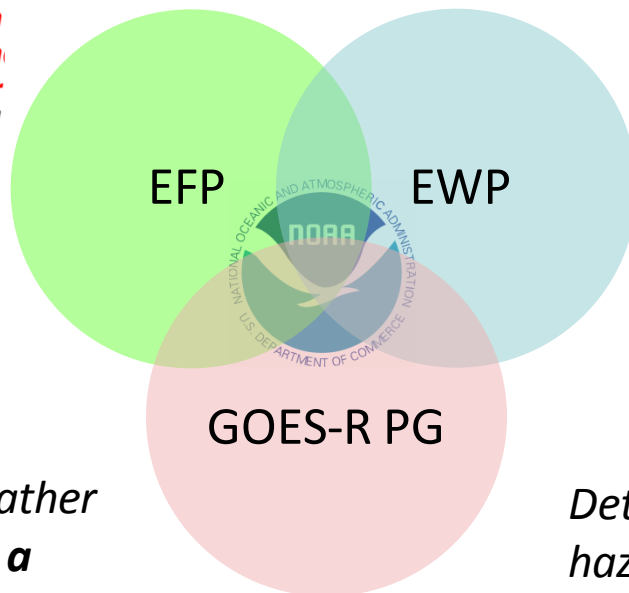**Duration**
-17 May – 18 June 2011

UWCI & OT

GOES-13

NOAA's Hazardous Weather Testbed

Experimental **F**orecast **P**rogram

EFP

EWP

Experimental **W**arning **P**rogram

GOES-R PG

*Prediction of hazardous weather events from **a few hours to a week in advance***

*Detection and prediction of hazardous weather events **up to several hours in advance***

- A Pseudo GLM (PGLM) total lightning product assisted in a severe thunderstorm warning at NOAA's Hazardous Weather Testbed on May 12, 2011 in Norman, Oklahoma. A rapid increase of the total lightning rate, along with the forecaster's interrogation of radar data, led to a severe thunderstorm warning, later verified with several severe hail reports.

- Research using total lightning trends to diagnose severe storm intensification indicates the potential to increase warning lead-time to 20 minutes or more

- The PGLM flash extent density was a useful precursor in identifying when the first cloud-to-ground strikes would occur. The PGLM preceded the first cloud-to-ground strike by approximately 30 minutes.

- GLM's ability to detect in-cloud lightning before the first ground strike provides a valuable early warning indicator to enhance lightning safety
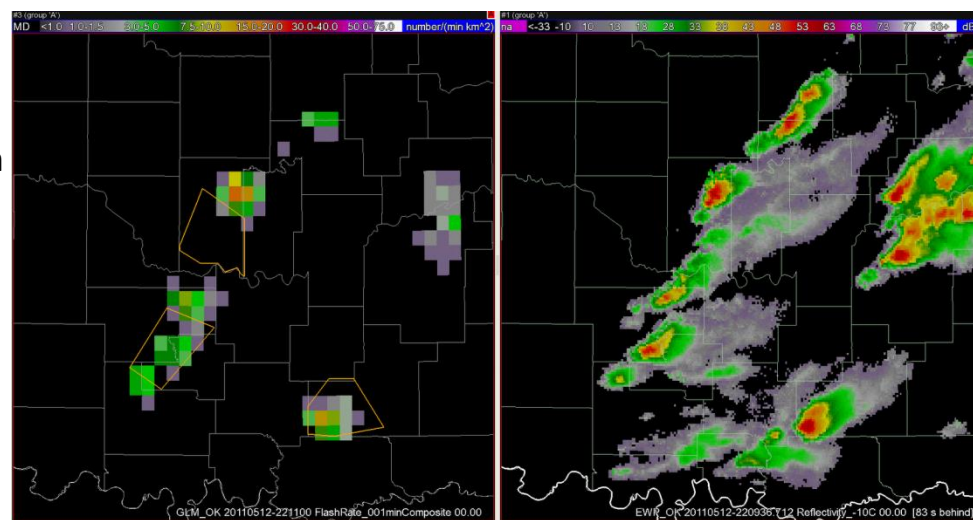
The PGLM flash extent density is on the left with the corresponding radar reflectivity on the right.

Using the GOES-12 Sounder to Nearcast Severe Weather
http://cimss.ssec.wisc.edu/model/nrc/
Robert Aune (NESDIS) and Ralph Petersen (CIMSS)

The CIMSS Near-casting Model uses hourly GOES Sounder retrievals of layered precipitable water (PW) and equivalent potential temperature (Theta-E) to predict severe weather outbreaks up to *6 hours in advance!*
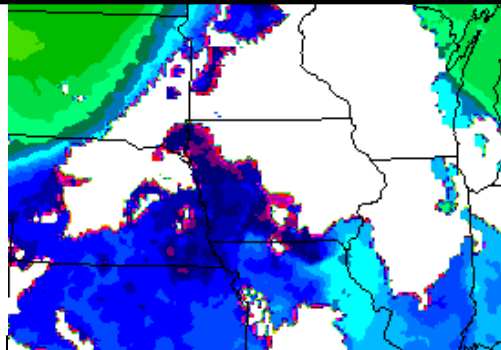
Hourly, multi-layered observations from the GOES Sounder are projected forward in time along Lagrangian trajectories forced by gradient winds. "Trajectory observations" from the previous six hours are retained in the analysis. Destabilization is indicated when theta-E decreases with height.

Limitations:
- Sounder channels support only two layers for near-casting
- Only useful for elevated convection – Sounder can't detect low-level moisture
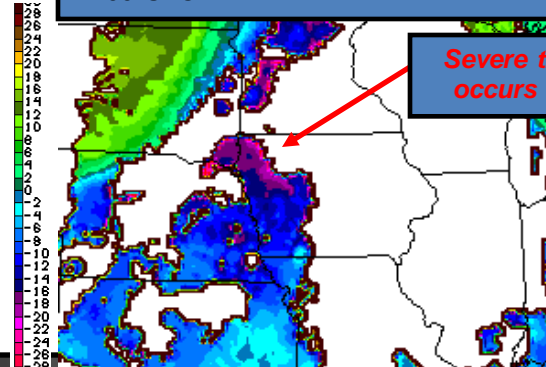- Frequent false alarms – Sounder can't detect inversions

One Example of a Successful Near-cast

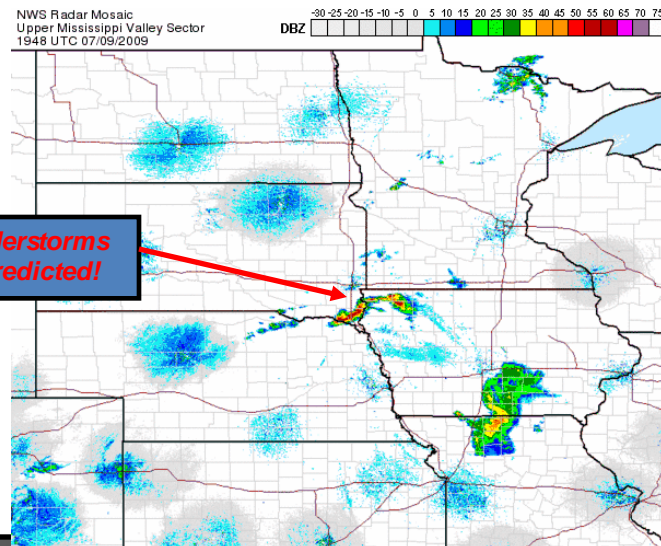Low-level Theta-E NearCasts shows warm moist air band moving into far NW Iowa by 2100 UTC.

Vertical Theta-E Differences predict complete convective instability by 2100 UTC.

Severe thunderstorms occurs as predicted!

6-hour NearCast for 2100 UTC
Low level Theta-E

6-hour NearCast for 2100 UTC
Low to Mid level Theta-E Differences

Rapid Development of Convection over NW Iowa between 2000 and 2100 UTC 9 July 2009

HWT 2011 Spring Experiment

Evaluating Products with greatest operational value

- Nearcasting products
    - Routinely used at all the desks in both the EFP and EWP
    - Did a good job showing where convection is likely and just as important… where it can be ruled out in the next 1-6 hours
    - SPC deputy director plans to make products available to operational forecasters this summer for evaluation
    - HPC representative requested a one week visit by Ralph Petersen or Bob Aune to introduce the products to forecasters
- LMA: pseudo GLM products
    - Routinely used in the EWP
    - Numerous examples operational value in generating forecasts and warnings and in identifying when 1st cloud to ground flash will occur
- Simulated CMI from NSSL WRF
    - Part of daily routine at the CI desk for model performance evaluation

- "The total lightning data is an excellent tool for monitoring convection, I see much promise for such data in the future, especially since CG strikes may be only a small fraction of the total lightning strikes within a given storm."

  □ "I utilized it as a situational awareness product and then kept a watch on my tried and true radar practices to issue the warning. The PGLM data gave me more confidence in my warning. Which is always something that is positive."

Demonstrations 2011
Hurricane Season Experiment

Location
-National Hurricane Center, Miami, FL
Focus
-Tropical Weather
Products
-Hurricane Intensity Estimate
-Enhanced "V"/Overshooting Tops
-Super Rapid Scan Imagery
-False color imagery product
-GOES-R natural color imagery product
-Rapid Intensity Index
-RGB Aerosol/Dust Product
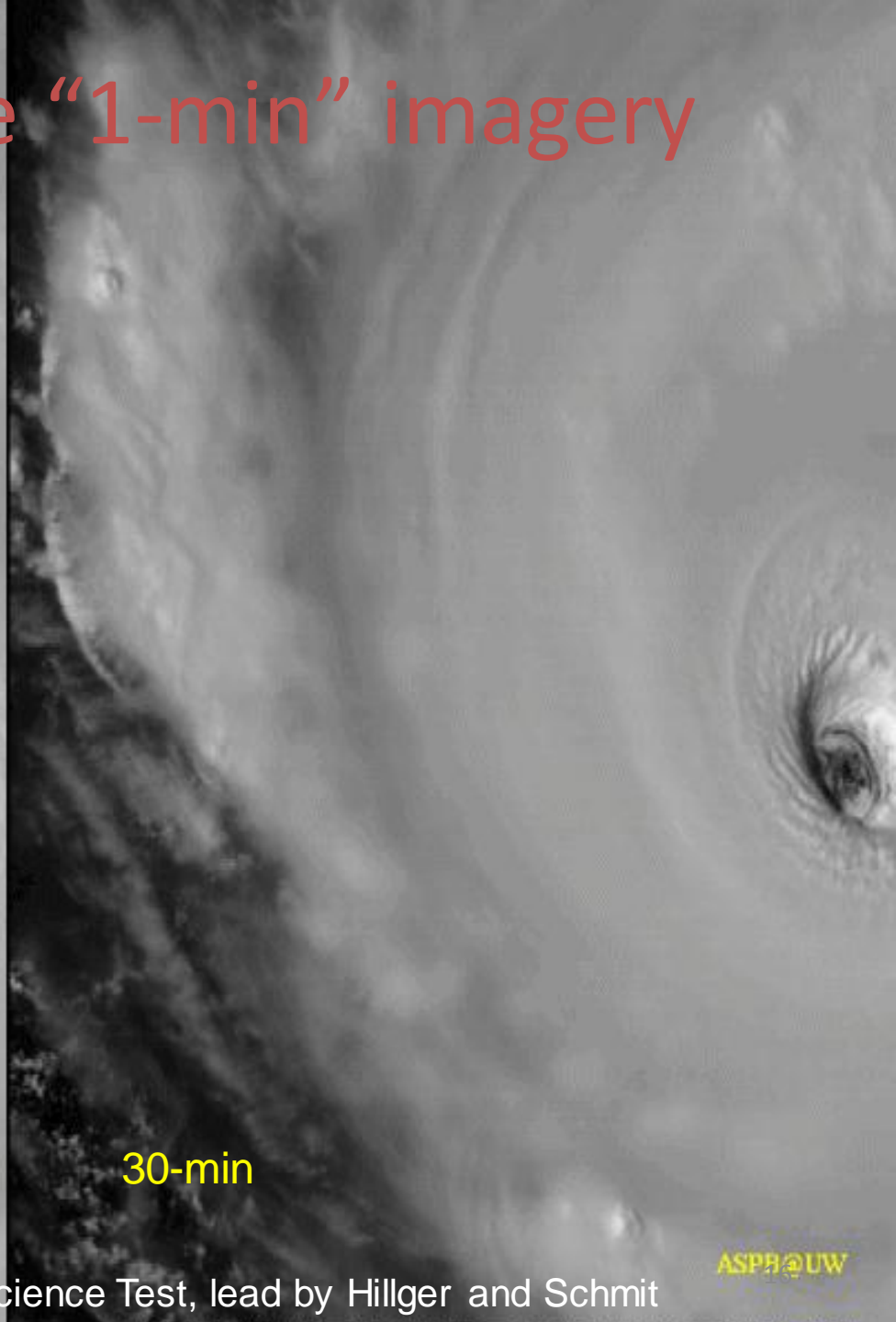-RGB Airmass Product
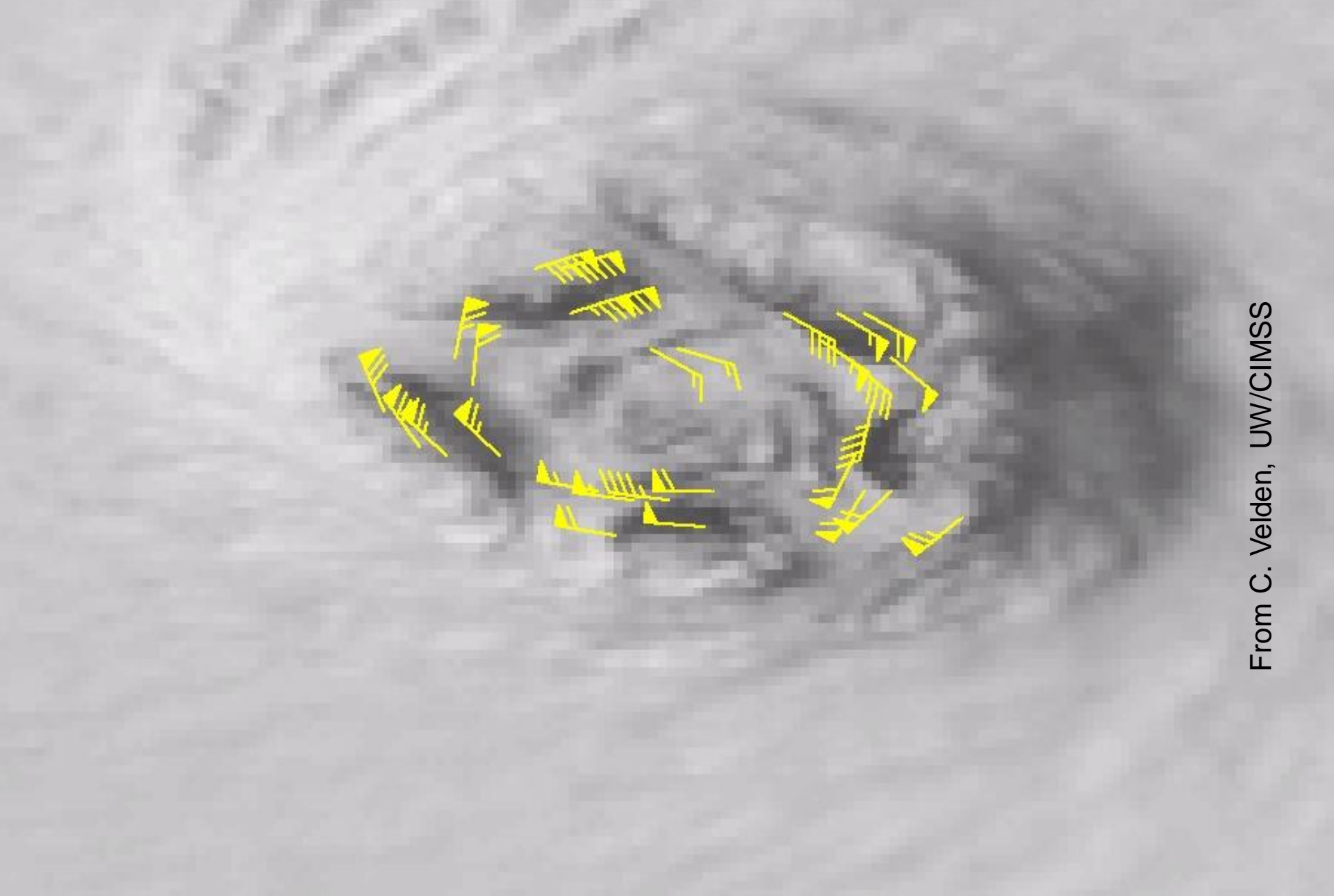-Saharan Air Layer Product
Duration
-1 Aug – 30 Nov 2011

NHC 2010

RGB Airmass
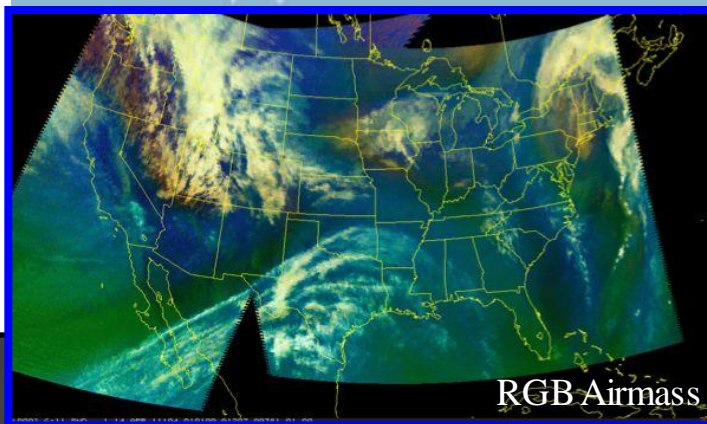
GOES-15: Sample "1-min" imagery
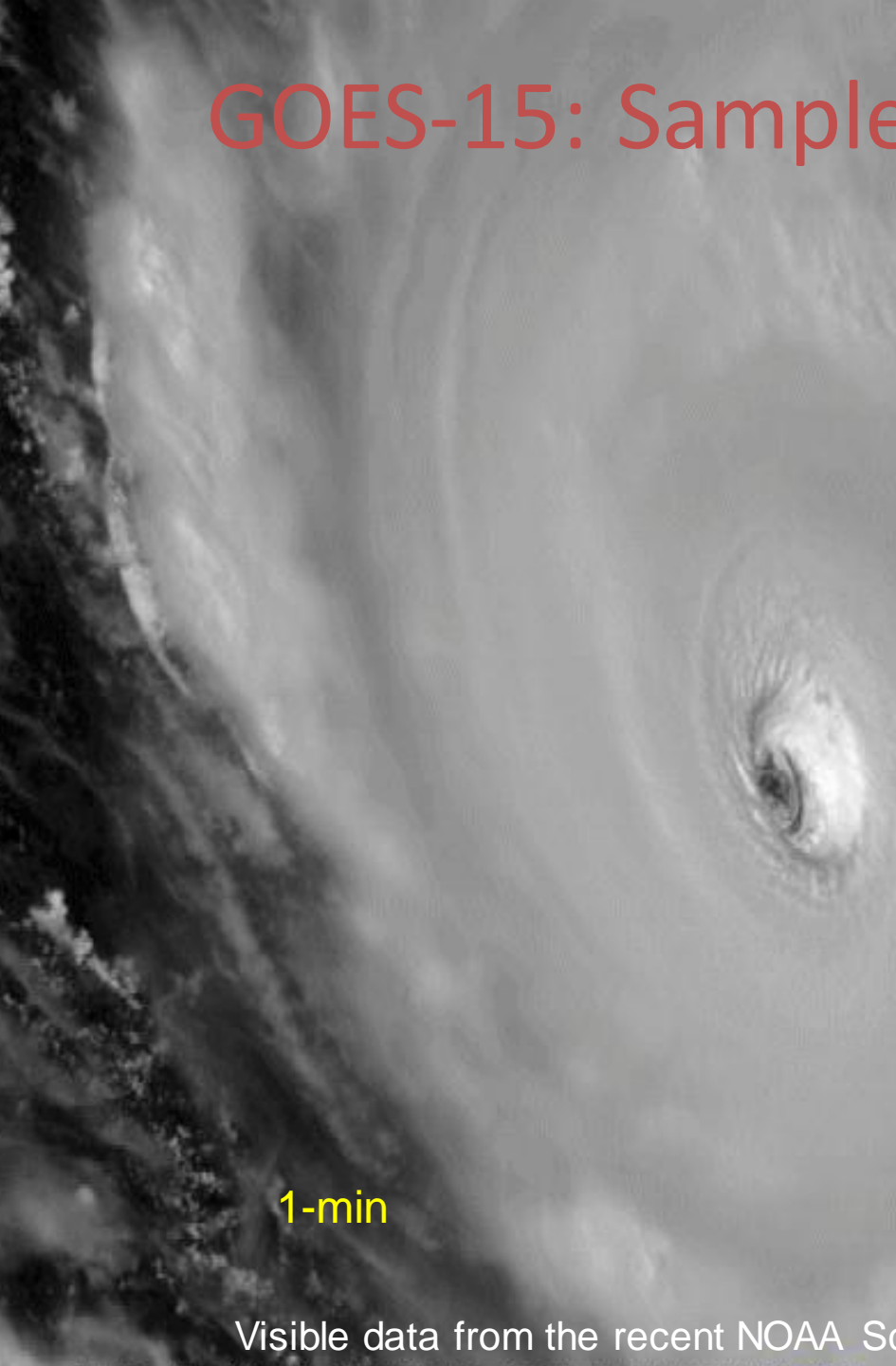
1-min

30-min

Visible data from the recent NOAA Science Test, lead by Hillger and Schmit
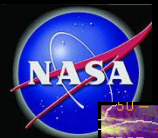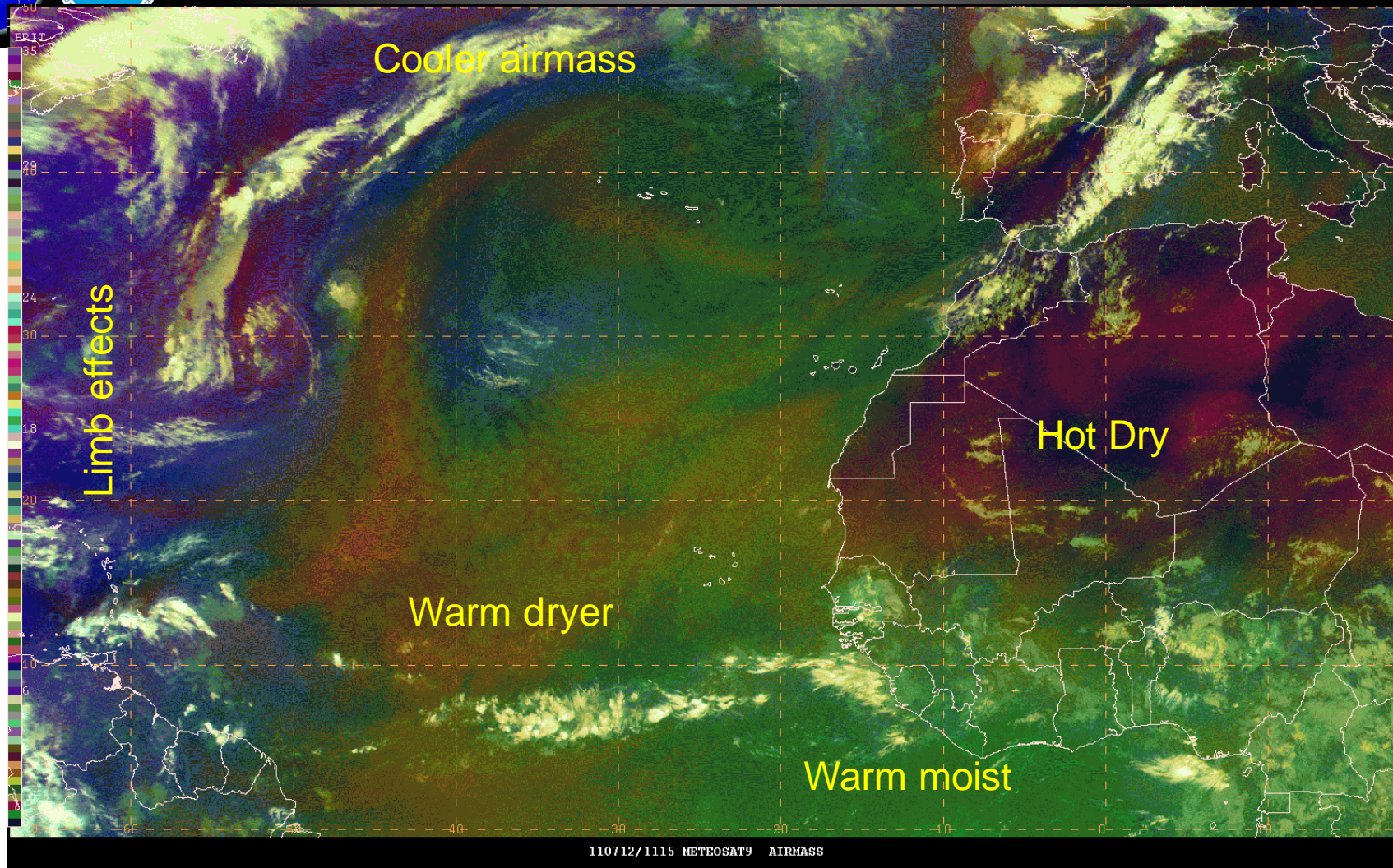
ASPB@UW

From C. Velden, UW/CIMSS

GOES-12 SRSO   12 SEP 03   13:07 UTC   HURRICANE ISABEL

Rapid scan (3-min) low-level winds in the hurricane eye

RGB Air Mass Product from SEVIRI

Cooler airmass

Limb effects

Hot Dry

Warm dryer

Warm moist

110712/1115 METEOSAT9 AIRMASS

Products evaluated and user feedback:

- Hurricane Intensity Estimate (HIE)
    - Generally comparable to ADT, but min SLP can be unrealistically low at times
    - Adjusted applied to HIE pressure estimate
- RGB Air Mass Product
    - Useful complement to the dust product
    - In some ways better separates the dry from moist air masses
    - At times product indicates polar air at very low latitudes
    - There are limb effects that could be corrected as a f(zenith angle)
- SAL Product
    - Animated version: improvement over static images
    - May be contamination near stratocumulus fields
- SRSO data
    - Large number of excellent cases obtained due to GOES-15 science test coinciding with the peak of the hurricane season
- Lightning based RII
    - Post season preliminary results show lightning reduces false alarms of rapid intensity forecasts
    - Additional testing needed to increase sample size

Ongoing Demonstrations 2011 Aviation Weather Experiment

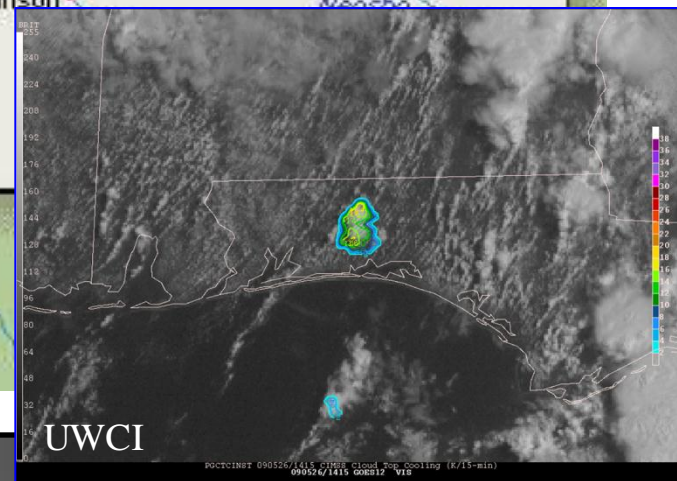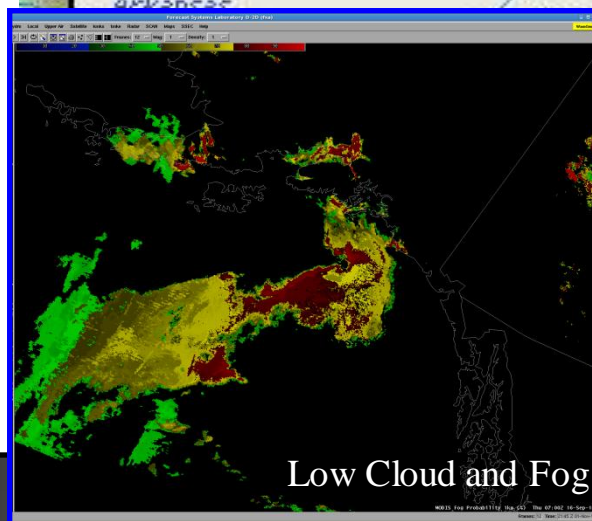**Location**
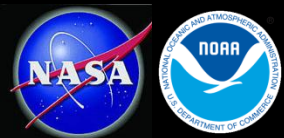-Aviation Weather Center, Kansas City, KS
Focus
-Aviation
Products
-Low Cloud and Fog
-SO2 Detection
-Volcanic Ash Detection and Height
-Aircraft Icing Threat
-UW Convective Initiation
-Nearcasting Model
Duration
-1 Jun – 31 Oct (TBD) 2011

Low Cloud and Fog

UWCI

Baseline Product: Volcanic Ash Product Suite

- Chile's Puyehue-Cordón Caulle Volcano erupted on June 4, 2011, forming a tall ash plume above the Andes Mountains

- The GOES-R Proving Ground provides near real-time volcanic ash retrieval products (using Meteosat SEVIRI data as a proxy for the GOES-R Advanced Baseline Imager) to identify a significant volcanic ash plume emerging over the Atlantic Ocean impacting aviation operations with many cancelled flights.

- Similar data was provided by STAR to the London Volcanic Ash Advisory Center (VAAC) during the eruption of Eyjafjallajökull in Iceland in May 2010.
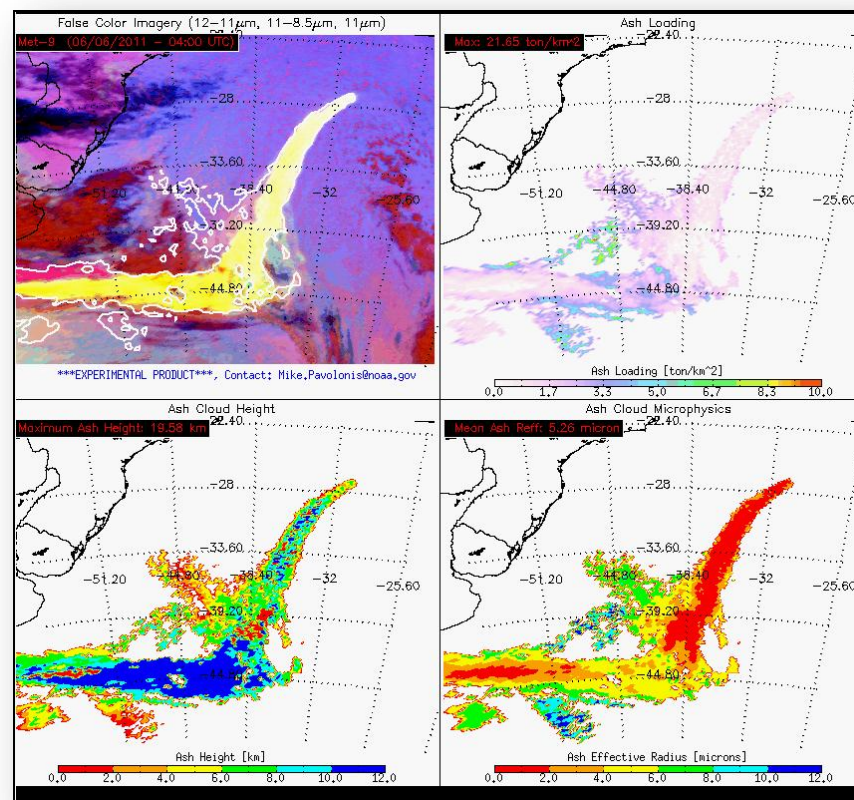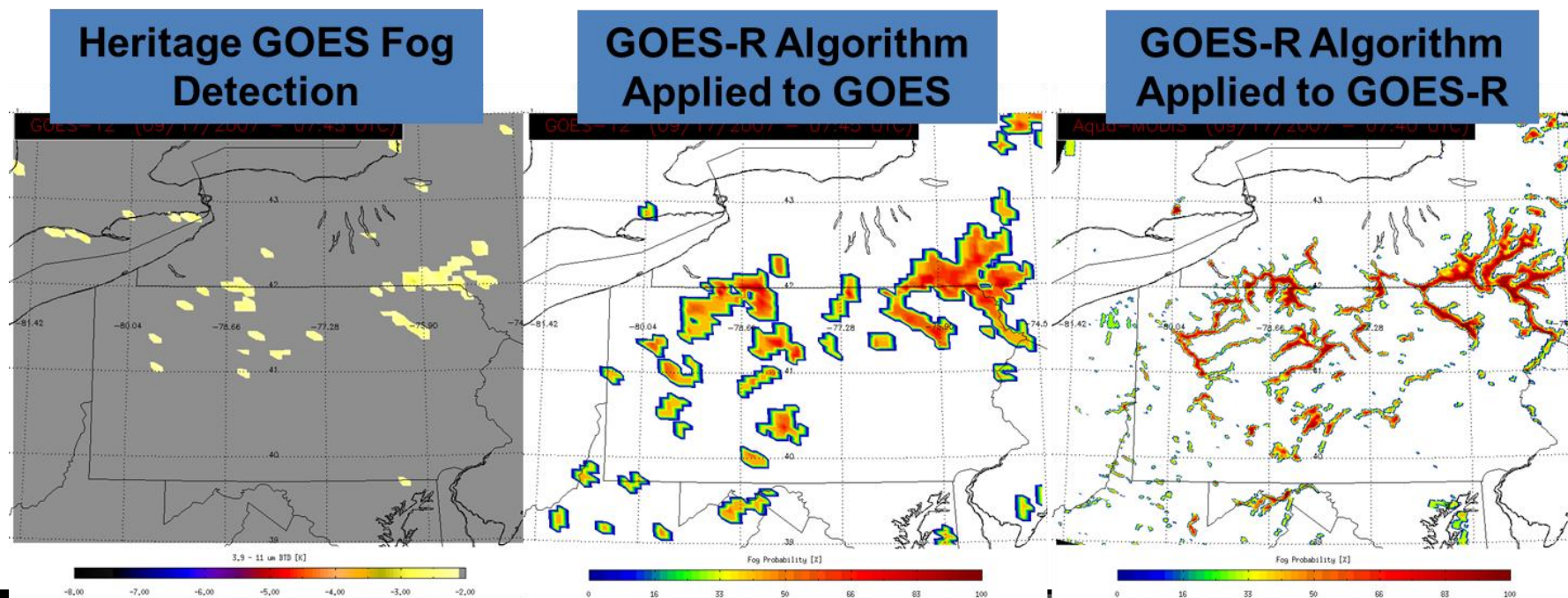
The GOES-R fog detection product will significantly improve geostationary satellite fog monitoring capabilities because:

- *Improved algorithm technology* - the GOES-R algorithm provides quantitative information on fog probability, while heritage GOES fog detection products are more qualitative in nature

- *Improved sensor technology* - the ABI has greatly improved spectral information, spatial resolution, and temporal resolution

Heritage GOES Fog Detection

GOES-R Algorithm Applied to GOES

GOES-R Algorithm Applied to GOES-R

Location

-Ocean Prediction Center, Camp Springs, MD

-NESDIS Satellite Analysis Branch, Camp Springs, MD
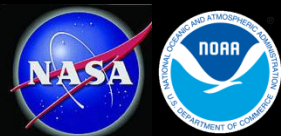
Focus

-Offshore T-Storms

Products

-Cloud/Moisture Imagery

-Convective Initiation

-Cloud Top Phase

-Cloud Top Height

-Cloud Top Temperature

-Enhanced "V"/Overshooting Top Detection

-Lightning Detection

Duration
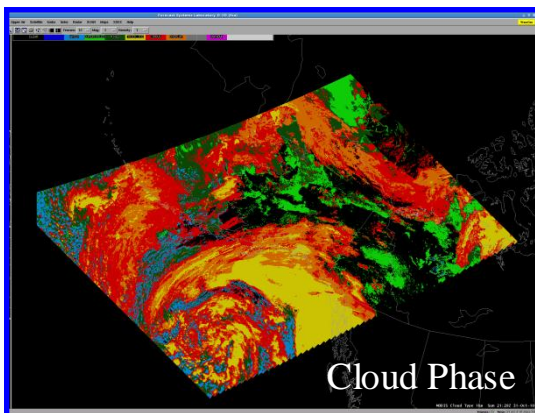
-Approx. June – Sept 2011

Pseudo GLM

Enhanced V/OT

Cloud Phase

Volcanic Ash
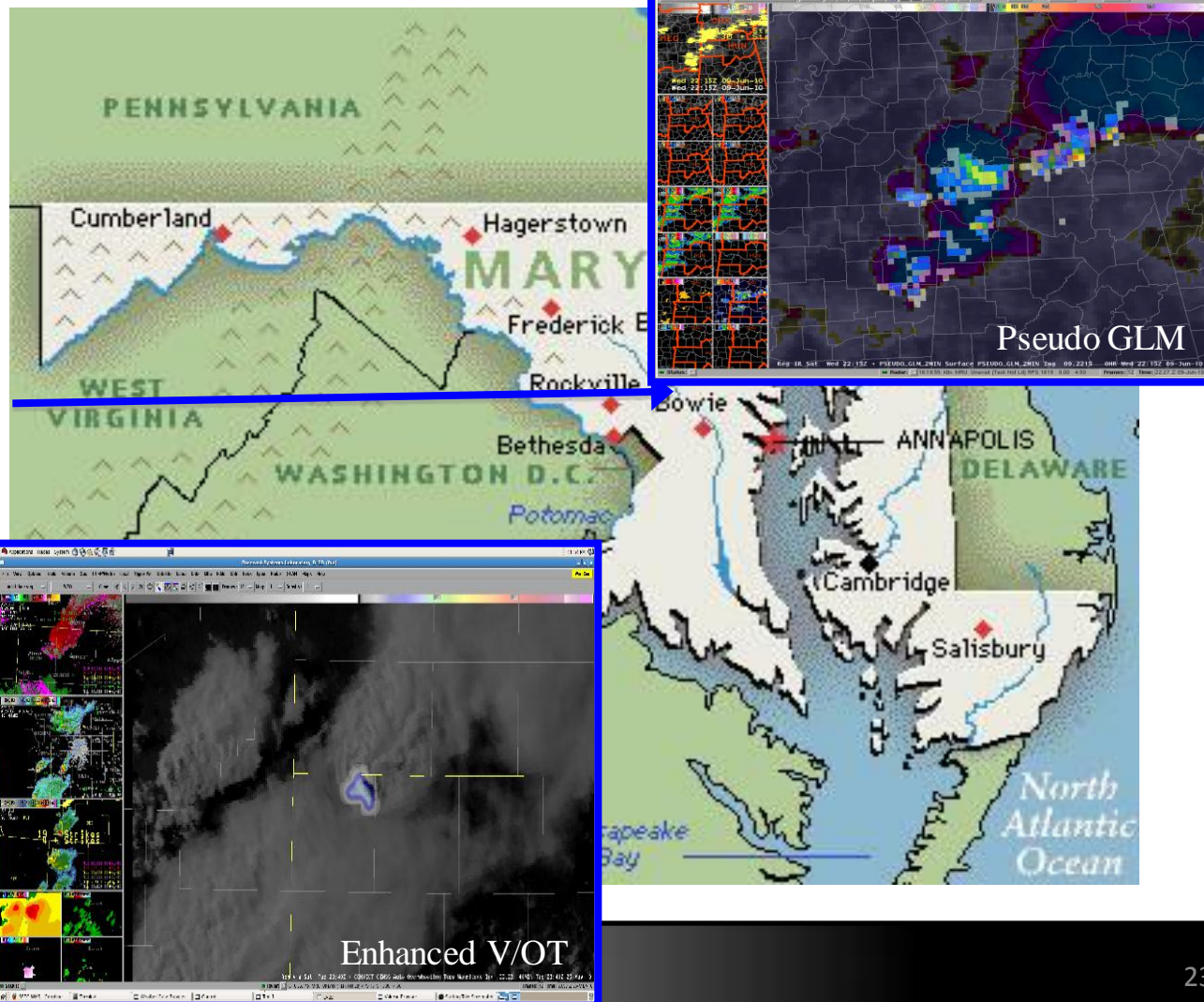
Location
-Alaska Region
- GINA
- WFO Fairbanks
- WFO Anchorage
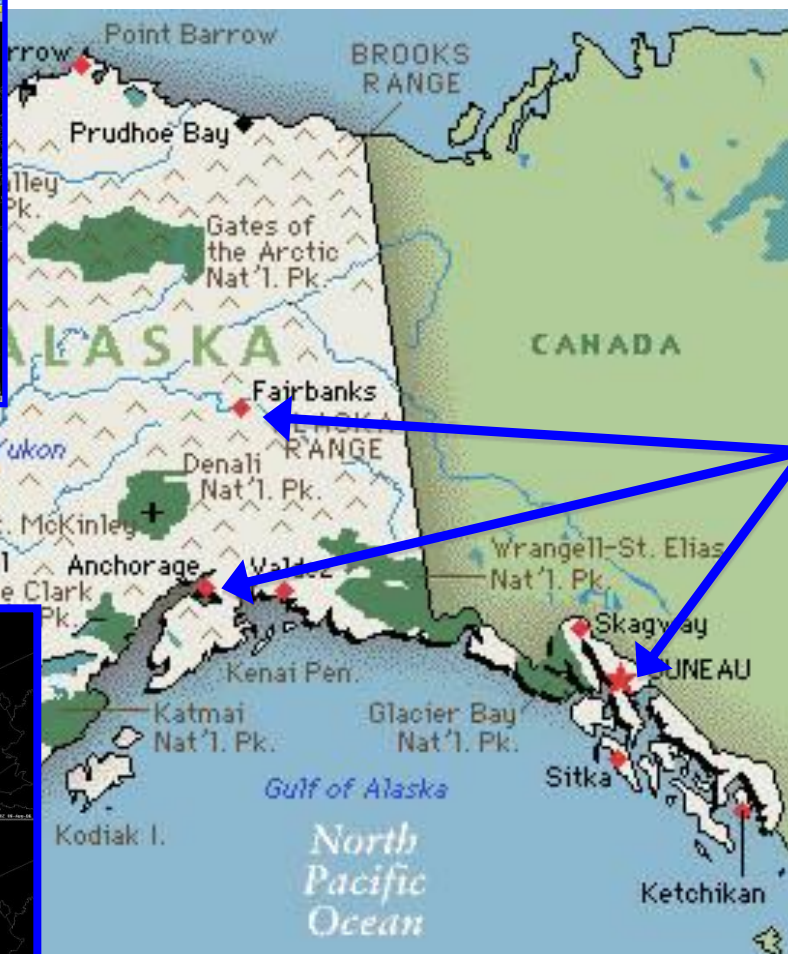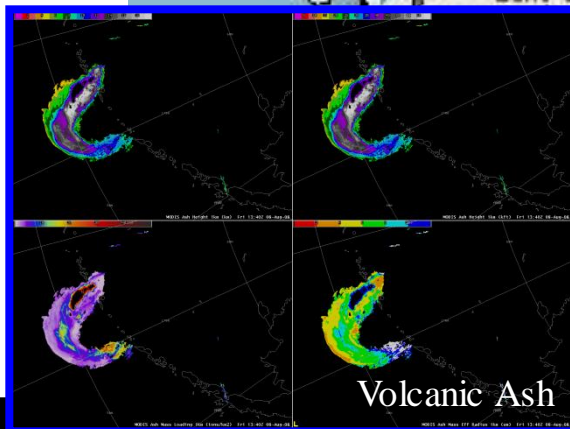- WFO Juneau
- AAWU

Focus
-Snow/Cloud/Ash/Aviation

Products
-Cloud Mask
-Cloud Phase
-Low Cloud and Fog
-SO2 Detection
-Volcanic Ash Detection and Height

Duration
- 6 Dec 2010 – 31 Aug 2011

Demonstrations 2011
HPC and SAB Demonstration

Location

-Hydrometeorological Prediction Center, Camp Springs, MD

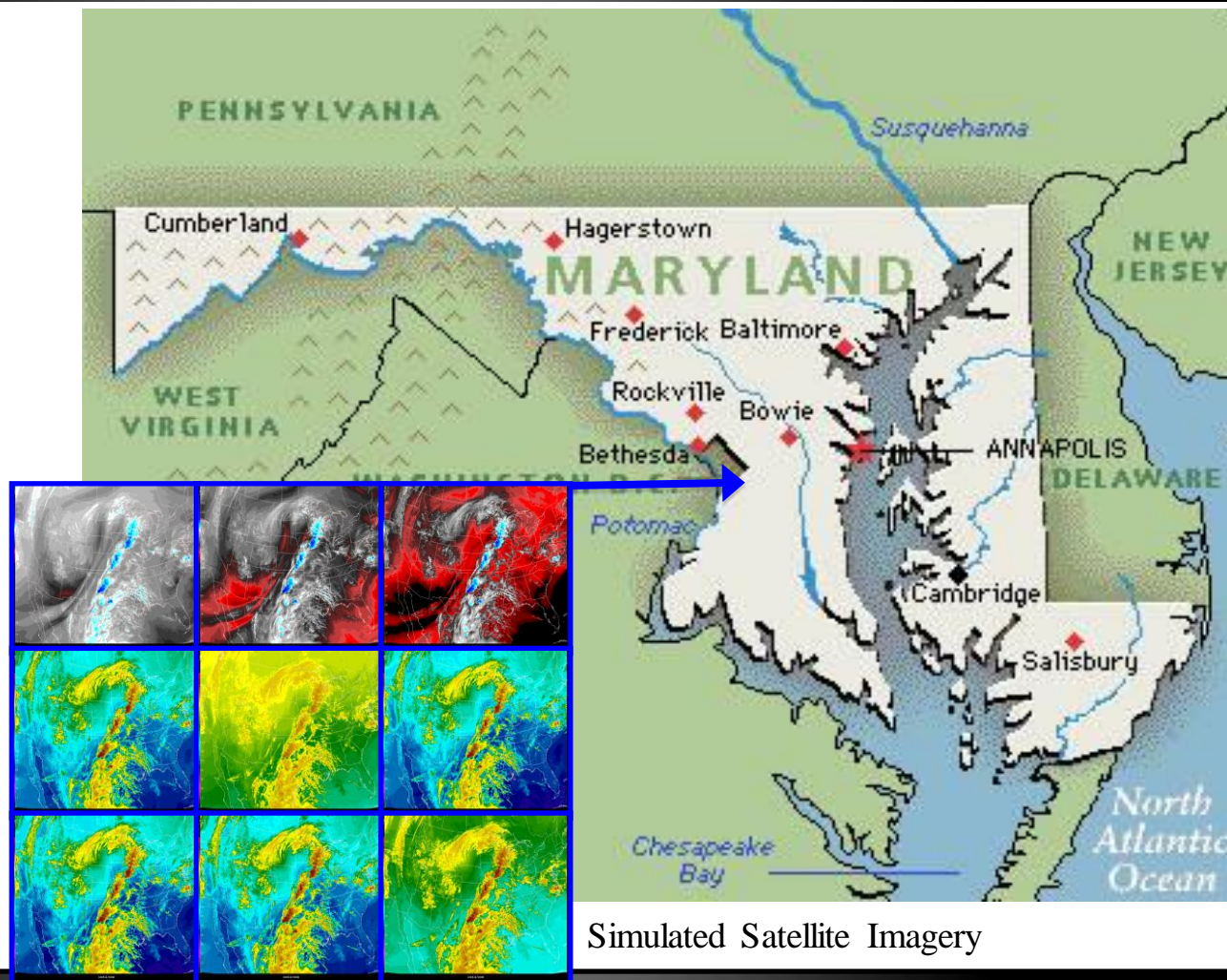-NESDIS Satellite Analysis Branch, Camp Springs, MD

Focus

-Precipitation/QPF

Products

-Cloud/Moisture Imagery

-Derived Motion Winds

-RGB Airmass

-Rainfall Rate/QPE

Duration

-Approx. July – Oct 2011

Simulated Satellite Imagery

Location

-UMBC

-EPA Region III
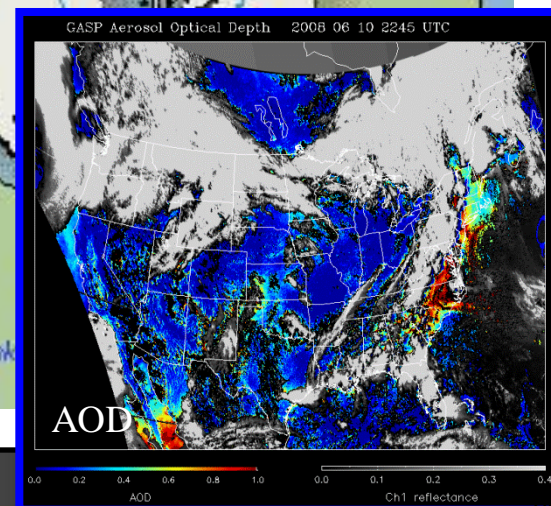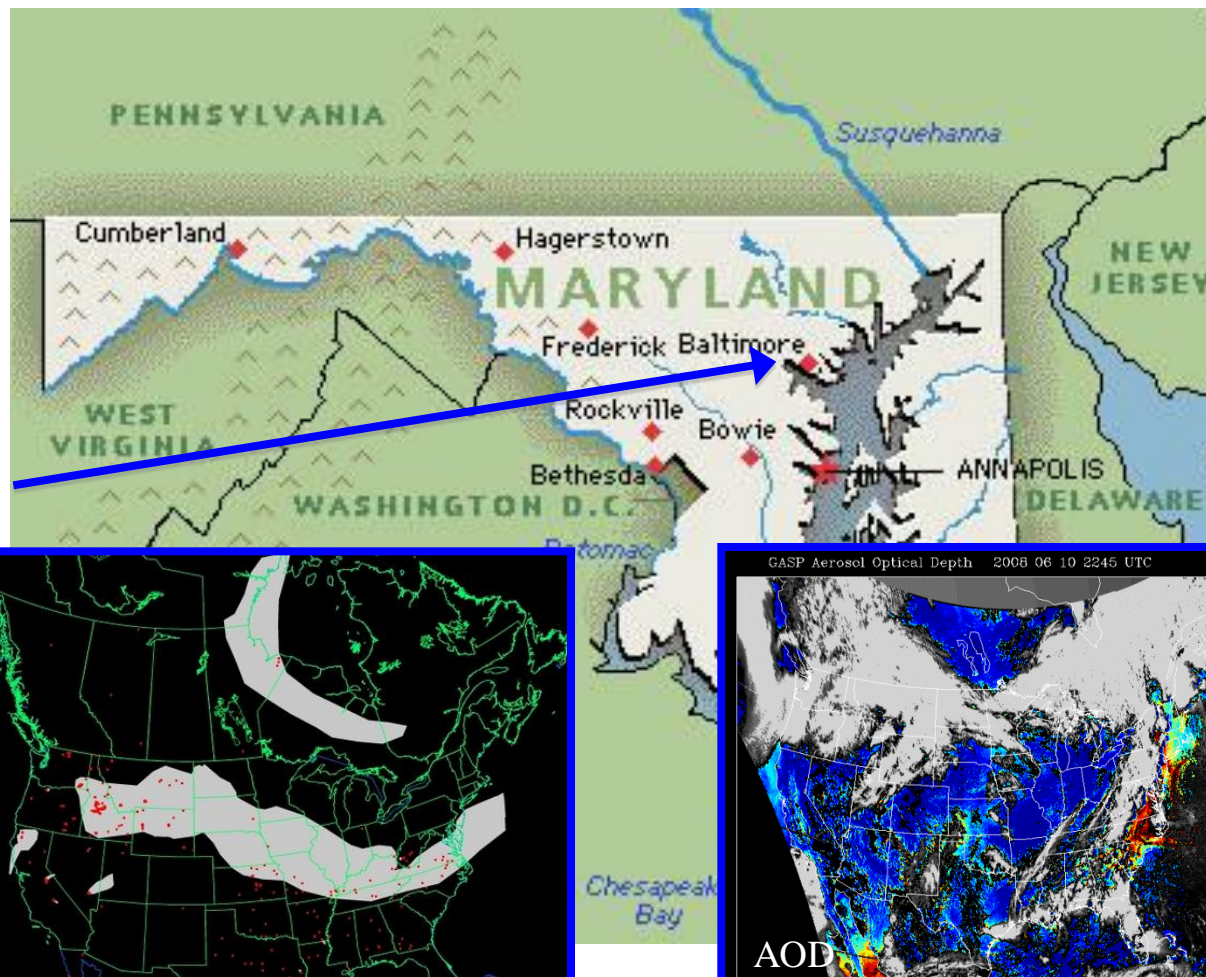
Focus

-Air Quality

Products

-Aerosol Optical Depth

-Aerosol Detection (Smoke/Dust)

-Fire/Emissions

-RGB Imagery

Duration

-Approx. 11 July – 24 2011

Notes

-Coincides with the DISCOVER-AQ experiment

HMS Fire and Smoke Product

AOD

Future Demonstrations 2011 Pacific Region Demonstration

Location
-Pacific Region
Focus
-Tropical Cyclone
-Heavy Rainfall
-Aviation
Products (List is under Review)
-Tropical Cyclone Intensity
-Lightning Detection
-Volcanic Ash Detection and Height
-SO2 Detection
-Aerosol Detection
-Rainfall Rate/QPE
-Oragraphic Rain Index
-Total Precipitable Water
-Atmospheric Rivers
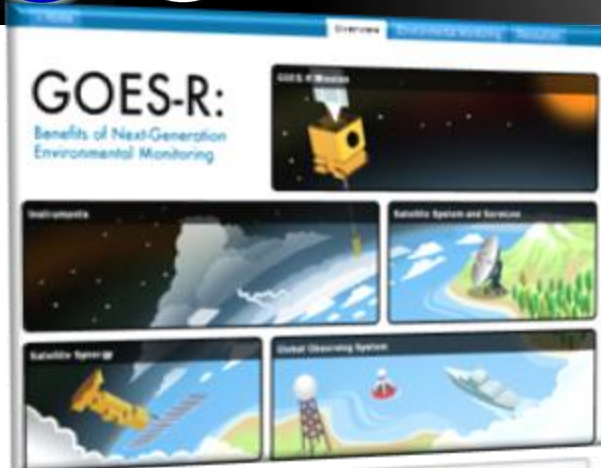-UW Convective Initiation
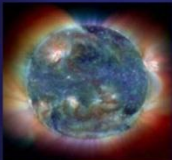**Start Date**
-TBD

2011 Product Demonstrations

– Space Weather: NWS SWPC and NESDIS NGDC

- Planning phase-implementation plan in development

- Solar thematic maps (SUVI)

- Products from NASA SDO to approximate GOES-R SUVI

- Create means to ingest and display GOES-R like Level 2+ products

Training and Education

Online training modules

- http://meted.ucar.edu/goes_r/envmon/
- http://cimss.ssec.wisc.edu/satmet/
- http://rammb.cira.colostate.edu/visit/video/goesr101/player.html
- http://rammb.cira.colostate.edu/training/shymet/forecaster_intro.asp

• **Proving Ground is both a source and a recipient of Training**

• **COMET Summer Faculty Course:** "Integrating Satellite Data and Products into Geoscience Courses with Emphasis on Advances in Geostationary Satellite System," Aug. 8-12, 2011.

• **Outreach Projects (with NWSFOs):** reach out to GOES-R Proving Ground Partners and connect with faculty and students to prepare for GOES-R

What is available now?

Listed/linked on GOES-R Home page

- Proving Ground Overview
- GOES-R 101 (SHyMet)
- Satellite Meteorology for Grades 7 – 12
- GOES-R: Benefits of Next-Generation Environmental Monitoring (COMET)
- GOES-R Trifold flyer
- http://www.goes-r.gov/users/training.html

Future Plans:
2012 And Beyond

- Demonstrate products and decision aids in NOAA Testbeds, NCEP Centers, WFOs, and the NWS Proving Ground at Training Center

- Transition from Warning Related Products to remaining Baseline Products, Day 2 Future Capability, Decision Aids, Decision Support Services

- Continue to develop, demonstrate, and test as part of decision support services

- Enhanced JPSS collaboration (fused products, VIIRS and SEVIRI as a proxy for ABI)

Summary

- GOES-R Proving Ground provides mechanism to:
  - Involve CIs, AWG, National Centers, NOAA Testbeds and WFOs in user readiness
  - Get prototype GOES-R products in hands of forecasters
  - Keep lines of communication open between developers and forecasters
  - Allow end user to have say in final product, how it is displayed and integrated into operations
- Proving Ground continues to grow and plans are in place for 2012 and beyond.
- For GOES-R to be a success, forecasters must be able to use GOES-R products on Day 1!

Backup